

**Summary Report of the
Meeting to Peer Review MPCA's
Draft Analysis of the Wild Rice Sulfate Standard Study
September 25, 2014 (Verbatim Excerpts)**

EC20 is Insufficient to Protect Wild Rice

Reviewer Conclusions and Recommendations

“The use of EC20 as the no-effect concentration is not considered protective of wild rice. In order to compare the results of this study to other published research, the panel recommends that a more conservative threshold, such as EC10 or EC05, with appropriate uncertainty factors, including confidence intervals, be calculated using a nonlinear regression approach that accounts for the sigmoidal (i.e., logistic) nature of the experimental response data.” (p. 4, first page of Reviewer Conclusions and Recommendations)

Summary of Reviewer Discussions

“Reviewers discussed whether EC20 is an appropriate level to use and what methods are appropriate to calculate effect concentrations.

- One reviewer asked if there are accepted conventions when selecting effect concentrations. Another reviewer responded that toxicology researchers typically accept effects on 5 percent of the population. The relevant question is “What do you want to protect?”
- A reviewer noted that both the endpoint and ecological relevance are important considerations in determining effect concentrations, because there will be a range of sensitivities depending on what endpoint is measured. It is also unclear in this case whether the NOEC speaks to the variability in the test. Researchers typically conduct at least six concentration exposures to determine an accurate NOEC. EC05, which would protect 95 percent of the population, has been used in lieu of a NOEC in Canada. Before setting an effect concentration, researchers need to know the statistical power of the test and what changes can be detected. Another reviewer expressed concern that the Analysis seems to assume that EC20 is equivalent to NOEC, though an effect on 20 percent of the population seems high.
- A reviewer had different thoughts about how to determine the effect concentrations. In combination with other datasets in the Analysis, researchers could conduct a population analysis with life table transition data and then model the wild rice population to look at the sensitivity of the population to different life stages. If population viability is highly sensitive to his life stage, it makes sense to adjust from EC20 to a more protective level, such as EC10. Researchers would need to determine the consequence of 10 or 20 percent mortality on the likelihood of extinction of a population over a long period, such as 50 years.” (pp. 14-15)

“One reviewer presented ten concerns he had with the Synthesis: 1. Toxic effects above EC20 need to be modified. MPCA should be careful not to imply there is a NOEC at EC20.” (p. 32)

Responses to Charge Questions from Dr. Gertie H.P. Arts

“I do not agree with deriving an EC20 as a value where no effects are to be expected. It is more appropriate to derive an EC10.” (p. F-4)

Responses to Charge Questions by Dr. Donald M. Axelrad

“I do not accept the argument that the hydroponics study EC20 is a no effects concentration for sulfide to wild rice; consider using an EC5 or EC10. The decision re which EC to use should be based on science and should be a number that allows for sustainability of wild rice cover – if that is MPCA’s desired outcome for protection of wild rice.” (p. F-11)

“Answering question number three as posed, regression analysis is appropriate for the hydroponics data. However I question if an EC20 value should be used as a no-effects concentration; instead consider EC5 or EC10.” (p. F-12)

Responses to Charge Questions by Dr. Patrick L. Brezonik

“Regression analysis is an appropriate way to analyze the seedling growth data to identify effect levels, and fitting experimental data to a logistic equation is the standard way to calculate EC50 and other EC values. I wonder why EC20 was chosen as an effect level and not EC10, or even EC05. At EC20, 20% of the population is affected, which seems high in terms of protecting wild rice stands. . . . It is difficult to estimate what level of exposure to sulfide would be protective of wild rice populations based solely on the results of short-term bioassays like the hydroponic studies, but it seems to this reviewer that a level affecting 20% of the population (i.e., EC20) is not protective. EC05 would be a more reasonable target level, although again one still has the problem that growth of seedlings is not necessarily the most sensitive life stage of wild rice plants. A weight-of-evidence approach that includes results from all phases of the study—short-term bioassays, long-term, whole life-stage studies (the mesocosms), and field observations—should be used to derive such a value.” (p. F-20)

Responses to Charge Questions by Dr. Susan Galatowitsch

“EC20 and EC50 are not adequately protective of wild rice—20% or 50% mortality/impairment should be considered a significant adverse impact to a wild rice population. EC5 or EC10 is, therefore, more appropriate.” (p. F-44)

There were *no* individual reviewers that endorsed an EC20 level as adequately protective of wild rice.

Threshold for Sulfide Toxicity to Wild Rice Shows Effects at 75 µg

Reviewer Conclusions and Recommendations

“The field study data (Figure 17 in the Analysis) support a working hypothesis of 75 µg sulfide/L in sediment porewater as a threshold for significant toxic effects, although this needs to be confirmed. Preliminary statistical analysis by the panel shows that the

threshold level may be as low as 20-50 µg/L. Overall, the panel concurred that the MPCA data support the preliminary finding of a threshold of < 75 µg/L, more so than the proposed level of 300 µg/L.” (p. 7)

Summary of Reviewer Discussions

“During this discussion, all reviewers expressed concern that 300 µg/L sulfide may not be protective of wild rice. . . One reviewer noted that Figure 17 in the Analysis clearly shows a wild rice response starting at 75 µg/L sulfide and sublethal effects starting as low as 30 µg/L.” (p. 23)

“One reviewer presented ten concerns he had with the Synthesis: 2. The statement in the Synthesis that the responses of wild rice from the field survey and mesocosm study are consistent with hydroponic study is misleading at best. The field survey results show effects starting at 75 µg/L sulfide.” (p. 32)

Responses to Charge Questions by Dr. Donald M. Axelrad

“Importantly, the field study suggests lower no-effects sulfide concentrations than those derived from the hydroponics study. The field study suggests that sulfide above 75 µg/L in porewater is problematic, and one panelists further analysis of the field data, indicated that levels above 20-50 µg/L could result in toxic effects. It appears that the field study may be better suited from which to derive a no-effects concentration for sulfide for protection of wild rice.” (F-12)

Responses to Charge Questions by Dr. Curtis D. Pollman

The MPCA histogram analysis of the Field Survey data indicates a change in slope occurring around 60 to 75 mg/L. I believe the histogram assessment is a useful analysis for showing the underlying, overall response in the field survey data, although it is arguably more an assessment of the upper limit of response because it ignores declines in percent cover that may be occurring at lower sulfide levels, but not sufficient to drive percent cover below the 5% threshold. (F-58)

Conceptual “Synthesis” Predicting Sulfide from Sulfate and Iron Goes too Far

Reviewer Conclusions and Recommendations

“Although the conceptual model described in the Synthesis is qualitatively correct, the current Synthesis goes too far in implying that sulfide concentrations in sediment can be predicted accurately by the multiple quantile regression model based on sulfate concentrations in the overlying water and acid-extractable iron in sediments.” (p. 9)

Summary of Reviewer Discussions

“It would be useful to have an experiment that examines whether iron would mitigate the ecological effects on wild rice of added sulfide levels. Additionally, current models do not account for the effects from oxygenated rhizospheres and iron plaques on root systems. MPCA needs to understand the mechanism of toxicity better before claiming to understand how iron mitigates sulfide stress. A reviewer responded that there is a substantial amount of literature about interactions between sulfate, sulfide, and iron. Another reviewer noted that these studies are on perennials, and wetland annuals have not

been studied in any detail. For a regulatory standard it would be inappropriate to extrapolate from other species.” (p. 28)

“Another reviewer was surprised by the lack of discussion of effects on wild rice plants. If MPCA is going to make site-specific standards based on iron and sulfate concentrations and compare these conditions with the hydroponics study to determine a NOEC, the sulfate concentration determined will not be protective.” (p. 32)

“The conceptual model seems qualitatively correct, but it presents an overly optimistic impression about our ability to predict whether toxic sulfide levels will occur in a given wild rice stand from the sulfate concentrations in surface water and acid-extractable iron in sediment.” (p. 33)

Responses to Charge Questions from Dr. Gertie H.P. Arts

“As the analysis of the field data survey is based on correlations, those correlations can be used for hypothesis generation. Subsequently, causal relationships need to be tested experimentally.” (p. F-5)

“In general, I support the synthesis performed by MPCA. Appropriate study components have been chosen. However, as stated before, I suggest to use the field study for hypothesis generation. These hypotheses can be tested in an experimental setting, e.g., in mesocosms. (p. F-9)

Responses to Charge Questions by Dr. Patrick L. Brezonik

“Figures 15 and 16 could be interpreted as evidence for iron limitation of wild rice growth, and this bears further analysis of the data and literature on wild rice and possibly additional studies. In addition, the important linkage between elevated sulfate levels and phosphorus internal cycling processes in lakes needs further investigation. Elevated sulfate levels could lead to less control of phosphorus levels in sediments by iron, which could exacerbate eutrophication problems—leading to more frequent and more intense algal blooms and a decline in water clarity. Such changes in water quality characteristics could have detrimental impacts on wild rice growth and abundance.” (p. F-25)

“The concluding paragraph goes too far in implying that the MQRA model can accurately predict concentrations of sulfide in sediment porewaters. If for no other reason than the uncertainties in the kinetics of solid-phase FeS formation, the statement at the beginning of the paragraph is not realistic. The conceptual model in the Synthesis seems qualitatively correct, but a schematic figure would be useful. In my view, the section and especially its last paragraph presents an overly optimistic picture of our state of knowledge regarding: (a) the quantitative effects of sulfate and sulfide on wild rice and (b) our ability to predict accurately whether toxic sulfide levels will occur in a wild rice stand from knowledge of sulfate levels in the surface water and the acid-extractable iron content of the sediment. I think the Synthesis needs substantial rethinking and rewriting. (p. F-27)